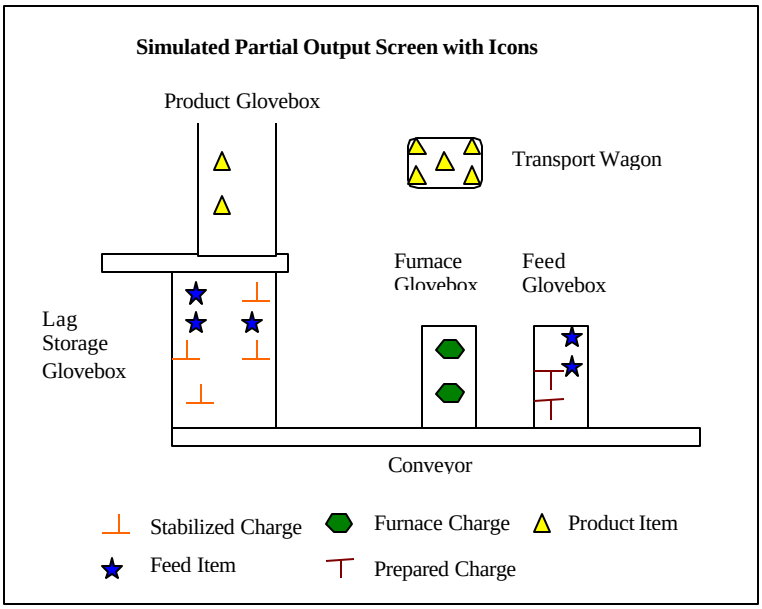
Simulation of the Stabilization Processing at the Plutonium Finishing Plant (PFP)

The Challenge

The Plutonium Finishing Plant (PFP) is one of the many facilities that were constructed at Hanford in support of the weapons complex fissile material production mission. PFP has two significant remaining missions: 1) stabilization and repackaging of plutonium-bearing materials and 2) storing Special Nuclear Material. Many processes and activities for stabilization and repackaging will be conducted including thermal stabilization of solid residues, plutonium solution conversion to solids, and cementation. These activities will be performed in several buildings and in various gloveboxes. Logistical choke points or holdups could occur due to the large number of tasks and plutonium items that will be in process at any given time The amount of lag storage for in-process material, criticality concerns, and dose considerations for operations personnel also need to be considered to optimize the complex processing activities.



The schematic above is a simulation of a process operation model, indicating where logistical choke points and resource constraints may occur.

Current Approach

Analysis of process needs for the individual processes are performed for flowsheet development, and consideration for interfaces with other facility activities is included. However, this does not provide an overall assessment of all potential concurrent activities, nor does it optimize for more than one process.

The strategic planning for stabilization activities at the facility, documented in the Integrated Project Management Plan, reflects apportionment of resources and budget to schedule major process campaigns, but does not provide for optimization of dose, lag storage, or address potential process logistical concerns.

Benefits and Features

- Identifies and solves logistical problems
- Finds best opportunities for dose reduction
- Optimizes lag storage capacity
- Illustrates personnel needs to optimize processing
- Allows “what if” investigations

New Technology

Arena® software is designed to model complex process operations, both in time and space, to enable projections of logistical choke points and resource constraints. The software also allows tracking of parameters associated with any given task, such as dose to operators or amount of waste produced. The level of detail in the model is complex, allowing nearly every action that is taken in the real operations to be included. Results for many process parameters can be obtained on reports, including personnel hours needed for any given operation, doses, wait times, and throughput rates. Input assumptions and parameters can be varied to assess the impact on the results, and the process sequence can be changed to seek improvements in dose reduction or throughput rates.

Demonstration Description

The Arena® was used to model PFP stabilization processes: thermal stabilization of residues, metal stabilization, solutions conversion to solids, and vault transfers for plutonium items at the PFP. Operations and engineering personnel at the PFP were involved in the model development, assuring that critical components such as waste operations, key steps in sealing material out, and transfer operations were properly included. Storage locations, gloveboxes, and process equipment were each illustrated by icons. The model was run on a time-step basis.

Demonstration Results

The model produced a simulation that appears to give production rate results very similar to those actually seen in operation of the thermal stabilization process.

The results were viewed on a step-wise computer projection of the process gloveboxes and buildings. The icons moved from vault storage to lag storage, then to feed preparation gloveboxes, to process equipment, back to lag storage, and eventually back to vault storage.

Further application of the Arena software is in the FY 2000 baseline planning to provide integrated modeling of several different PFP processes.

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